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Symposium Title: Silicides, Germanides, and Their Interfaces

APPLICATION OF NOVEL EPITAXY TECHNIQUES TO THE GROWTH OF $CrSi_2$.* Robert W. Fathauer, Thomas George, Eric W. Jones, and W. Thomas Pike, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA; Alice E. White and Kenneth T. Short, AT&T Bell Laboratories, Murray Hill, NJ.

$CrSi_2$ is a semiconductor with an indirect band gap of 0.3 eV and a hexagonal structure, with a 0.1 % mismatch to the (1 11) face of Si. Attempts at growth of single-crystal films of $CrSi_2$ on Si by molecular beam epitaxy have not been successful, but formation of single-crystal layers of $CrSi_2$ in Si substrates has been demonstrated more recently by "mesotaxy". One purpose of this study is to demonstrate the usc of such a buried layer formed by mesotaxy as a template for further growth by MBE. An ultimate goal of such a capability is the fabrication of single-crystal layers of $Cr_{1-x}V_xSi_2$ alloys, with band gaps tailorable from 0.3 down to 0.0 eV. Another approach to achieving such ternary silicides is "allotaxy", with codeposition of Cr and V along with Si.

"Mesotaxy" samples were first subjected to a CF4 plasma to remove the Si layer capping the $CrSi_2$. A network of cracks is present in the $CrSi_2$ after etching due to a sizable thermal expansion mismatch between $CrSi_2$ and Si. After cleaning in H2S04:H202, Cr was deposited in an MBE system at 700°C. Transmission electron microscopy and atomic force microscopy analyses of these samples indicate that epitaxial CrSi2 forms on top of existing CrSi2 regions. Small mis-oriented $CrSi_2$ grains form in the cracks. XPS analysis after various chemical cleans of the plasma etched samples indicates that CrF_x species formed during plasma etching arc not readily removable.

Rutherford backscattcring/channeling and TEM analyses were performed on "allotaxy" MBE samples as grown and after annealing at 1000°C- 1100"C. -The as-grown structure contains a high density of small $CrSi_2$ particles within single-crystal Si, the latter containing a high density of crystallographic defects. While considerable ripening of $CrSi_2$ particles was observed after annealing, coalescence into a continuous $CrSi_2$ layer was not achieved.

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